

BRIDGE WATER AND SEWER LINES

Introduction

This memo discusses the responsibilities of the engineer performing the design for water and sewer lines installed within bridge structures.

Engineer Responsibilities

- Provide assistance to the Bridge Engineer and Encroachment Permit Engineer in designing or reviewing the plans and specifications for water and sewer lines on the bridge.
- Provide comments to District staff, or local Agency owner of the utility.
- Determine the type of materials to be used for utility lines and casing pipes.
- Provide details of utility supports and their connection to the structure.

Applicability

All water (drinking and storm water) and sewer installation requirements on bridges are required to comply with these requirements. The engineer shall review the installation plans for bridge design and other Caltrans programs.

Design Principles

Water and sewer line installation plans must meet the following basic requirements, which have been developed to minimize risk to the public and structure and to minimize maintenance problems in the vicinity of the structure. It should be noted that every bridge is a unique design; therefore, every water and sewer line installation is a custom design specific to the particular bridge. These requirements include:

1. The design will contain any potential leaks, within the limits of the bridge, and any liquids are to be carried away from the structure and released in a controlled manner away from the traveling public. This is a major consideration with sewer lines.
2. The interference of the utility installation on construction of the bridge should be minimized. The pipeline can be installed in the casing pipe after the bridge is constructed. In this situation the bridge contractor will often only install the casing pipe and supports.
3. Water and sewer lines shall be designed to accommodate thermal expansion and transverse seismic bridge deflection. This is accomplished by placing an expansion fitting or expansion deflection fitting inside the structure near the bridge abutment.
4. The pipeline should be designed to accommodate large lateral displacements (up to 12 inches) between the abutment back wall and end diaphragm by placing deflection fittings within the bridge. The deflection fittings cannot be cased.

**Design
Requirements**

The following requirements for water and sewer lines are necessary to protect public safety and the structure:

1. All liquid carrying pipelines in or on bridge structures must be encased. The casing should extend the greater of: 5 feet beyond the approach slab, 20 feet beyond the abutment back-wall or 5 feet beyond the wing walls. Casing must be grouted in the abutment back wall. Fully cased pipe should be wrapped with building paper before casting into bridge abutments or dry packing.
2. In single span and double span bridges, a box girder cell may be considered encasement for only waterlines if the following conditions are met:
 - a. Access is made available to mechanical devices placed within the structure;
 - b. The carrier is a metal pipe;
 - c. Provisions are made to adequately drain the cell in the event of pipe rupture and drainage openings shall not be located over traffic; and
 - d. A thimble casing is provided from the abutment back-wall into the approach fill. The limits of the thimble casing shall comply with thimble casing detail provided in Section 16 of Bridge Design Details Manual.
3. Sewer lines must be cased for their entire length inside of box girder structures and on open girder bridges. Sewer line casings may be broken near abutments to allow for placement of expansion or expansion/deflection fittings. Soffit drainage openings must be located downhill and in the immediate vicinity of the break in casing pipe. Casing pipe limits are as noted in 1 above. Distance between soffit openings and the abutment shall not be more than 10 feet. Soffit opening shall be a minimum of 2'x3'. Soffit opening shall be located under flexible expansion joints to allow maintenance for expansion joints and controlled discharge of water to the roadway shoulder.
4. Utility supports should be designed to withstand the loads and constructed of steel or concrete. Cast in place supports such as inserts and anchor bolts shall be shown on the contract plans. The utility support should be provided with a strap or type of restraint to prevent the utility from falling off the support under seismic loading. The strap should provide for thermal expansion independently from the superstructure in the longitudinal direction.
5. Hanging supports must be fabricated from steel. The steel should be hot dip galvanized after fabrication. Supplemental lateral supports should be provided for the carrier line.

6. Supports located on soffit slabs are to be made of concrete. Concrete cradle supports should be designed to withstand the loads and cast in place with the soffit slab or after the slab has been poured, epoxy and dowels must be used for the supports. Precast concrete supports may also be used if provisions are made on the utility installation plans for the soffit slab to be ground flat prior to installation of the support. Straps on concrete supports should not be clamped down tightly except at the support near the center of the bridge, to allow the pipe to move independently of the superstructure longitudinally as previously noted.
7. Pipe shall conform to American Water Works Association (AWWA) specifications.
8. Water and sewer carrier lines shall be welded steel or ductile iron. Plastic pipe such as PVC, HDPE, and FRP are not allowed in State bridges due to their higher thermal expansion.
9. Steel lines carrying sewage or other corrosive materials shall have corrosive protection measures included. Protection includes but is not limited to additional steel thickness, cement mortar, epoxy, polyurethane, or nylon-based polyamide lining.
10. On structures with seat type, end diaphragm, and shear key abutments, water and sewer lines under pressure (not gravity flow) shall be designed to accommodate relative seismic displacements. This is normally accomplished by:
 - a. Placing expansion deflection fittings on the carrier line inside the bridge or in a vault adjacent to the abutment on seat type abutments. The Office of Electrical, Mechanical, Water and Wastewater Engineering has standard details for this type of installation. Force balanced flanged double ball expansion joint is recommended for seismic expansion in the pipe. Mechanical expansion joints are not accepted as seismic expansion fitting. A seismic expansion joint at each abutment in the water supply line is required.
 - b. Using sliding supports adjacent to the abutment that will allow the carrier line pipe to accommodate the displacements.
 - c. Longitudinal expansion fittings are required on end diaphragm and shear key type abutments to accommodate thermal expansion because the abutment type prevents shear movement.
11. Water and sewer lines shall not be cast into concrete or placed into deck slabs, sidewalks, or barrier rails.

12. An air release valve is required at the high point of pressurized water and sewer lines. Air release valves must be installed within the bridge cell to allow for proper operation of the fitting and access for maintenance. Access to this mechanical device may be required by manhole from the deck. The manhole location should be coordinated with the utility owner through the District Project Engineer.
13. Water and sewer lines with less than 40 inches of cover over the line in the traveled way require structural protection from wheel loads or an analysis showing that they can sustain wheel loads. A standard structure approach slab is not considered adequate structural protection. Providing casing pipes can offer some structural protection.
14. In box girder bridges, the structure depth must be adequate to accommodate the pipe support height, pipe diameter, pipe casing (if any) diameter and expansion thickness.
15. A dirt stop shall be provided to avoid dirt buildup between the pipe and the casing.
16. Pipe protection shields are required to allow the pipe to slide on the support cradle and shall be shown on the plans.
17. Thermal and seismic expansion calculations are required.
18. The following notes shall be shown on the bridge utility details plans:
 - a. Supply line shall be installed parallel to bridge deck.
 - b. Pipe shall tightly clamp at the two pipe supports nearest the center of any two expansion assemblies. At all other pipe supports, the pipe clamp shall be shimmed with steel washer plates to provide 1/4" clearance and allow for expansion in both directions.
19. For sloped bridges, additional restraints are necessary to hold the pipe from sliding downhill.
20. Utility openings in end diaphragm bridges must be sized for maximum deflection.

Standard Plans

Standard plans B14-3, B14-4 and B14-5 are available for irrigation lines less than four inches. Standard Plans B6-10, B7-10 and B7-11 are available for other utility details. These plans are attached for reference.



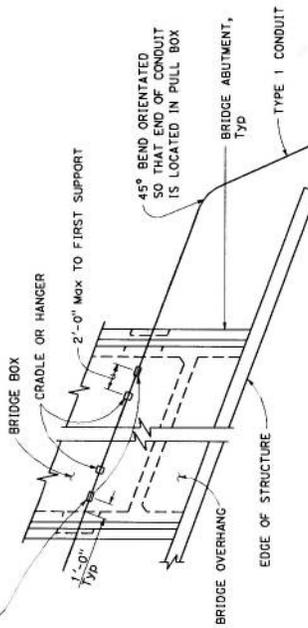
Robert E. Travis
Office of Transportation Architecture



J. Stephen Schoff
Office of Electrical, Mechanical,
Water & Wastewater Engineering

COUNTY: _____ ROUTE: _____ TOTAL SHEETS: _____ SHEET NO.: _____
 PROJECT: _____
 REGISTERED ELECTRICAL ENGINEER
 J.S. SPORN
 LICENSE NO. 423012
 MAY 20, 2011
 PLANS APPROVAL DATE
 REGISTERED PROFESSIONAL ENGINEER
 STATE OF CALIFORNIA
 THE STATE OF CALIFORNIA OFFICE OF THE REGISTERED PROFESSIONAL ENGINEERS
 FOR THE ACCURACY OF THE INFORMATION CONTAINED HEREIN, I HEREBY CERTIFY THAT I AM THE AUTHOR OF THESE PLANS AND I AM A LICENSED PROFESSIONAL ENGINEER IN THE STATE OF CALIFORNIA.

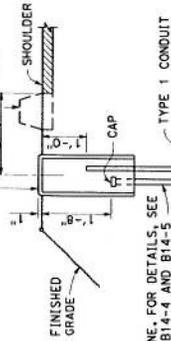
CONDUIT EXPANSION FITTING. SEE STANDARD PLAN ES-9B DETAIL X. PROVIDE FOR A MINIMUM MOVEMENT OR 1/2" (1+ 1/2") AT EACH ABUTMENT WHERE NO EXPANSION JOINTS ARE LOCATED. OTHER EXPANSION ASSEMBLIES SHALL PROVIDE MOVEMENTS ACCORDING TO ADJACENT EXPANSION JOINT SIZE. SUPPORTS ARE TO BE LOCATED 2'-0" MAXIMUM EACH SIDE OF EXPANSION ASSEMBLIES.



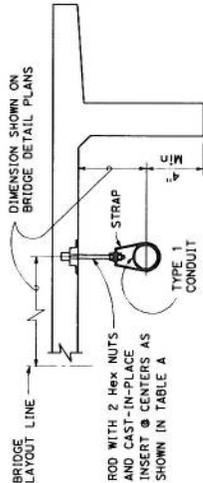
NOTE:
Details of electrical conduit system are to supplement those shown on the Road Plans.

PLAN
COMMUNICATION OR
SPRINKLER CONTROL CONDUITS

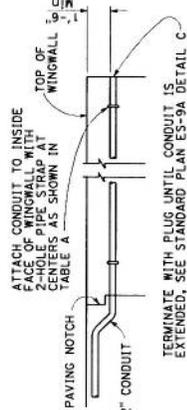
#5 CONCRETE PULL BOX AND EXTENSION. SEE STANDARD PLAN ES-8



DETAIL B



OTHER THAN BOX GIRDER
CONDUIT HANGER SUPPORT DETAILS



CONDUIT IN OVERHANG-WINGWALL DETAIL

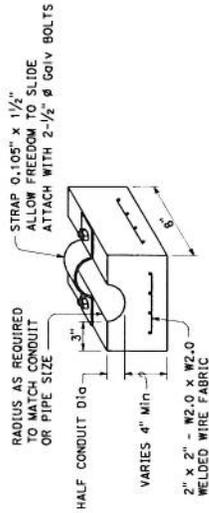
CONDUIT LOCATIONS

(For 2" conduit, only except as noted)
For location see Bridge Detail Plans.

NOTES:
1. The maximum conduit sizes shown are for a straight run across the bridge without pull boxes.
2. In a bridge railing with lighting standards or pull boxes, reduce size of affected conduits as needed.

TABLE A

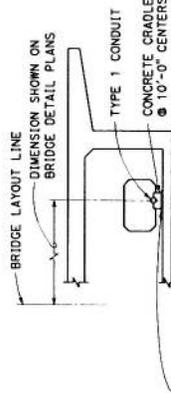
SUPPORT SPACING	CONDUIT ROD STRAP	CONDUIT	CONDUIT
10'-0"	0.090" x 1"	2 1/2" OR LESS	3 1/2"
10'-0"	0.090" x 1"	3/8" Ø	3/8" Ø
10'-0"	0.105" x 1 1/2"	1/2" Ø	1/2" Ø
10'-0"	0.105" x 1 1/2"	3/8" Ø	3/8" Ø



NOTES:

1. Cradles to be precast concrete.
2. Secure all cradles to bottom slab of bridge with epoxy adhesive, except as provided below.

CONCRETE CRADLE



UNDER THE FIRST CRADLE SUPPORT INSIDE BRIDGE NEAR ABUTMENT OR HINGE, EPOXY 12 GAGE GALVANIZE STEEL SHEET 2'-8" x 1'-4" TO THE FLOOR OF CELL. DO NOT SECURE CRADLE TO STEEL SHEET. CRADLE SHALL BE FREE TO SLIDE TO ACCOMMODATE LATERAL MOVEMENT.

BOX GIRDER
CONDUIT SUPPORT DETAILS

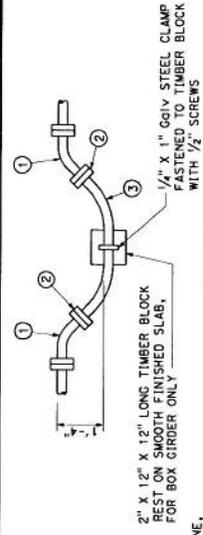
CONDUIT IN BRIDGE RAILING

STATE	COUNTY	ROUTE	POST MILES	SHEET NO.	TOTAL SHEETS

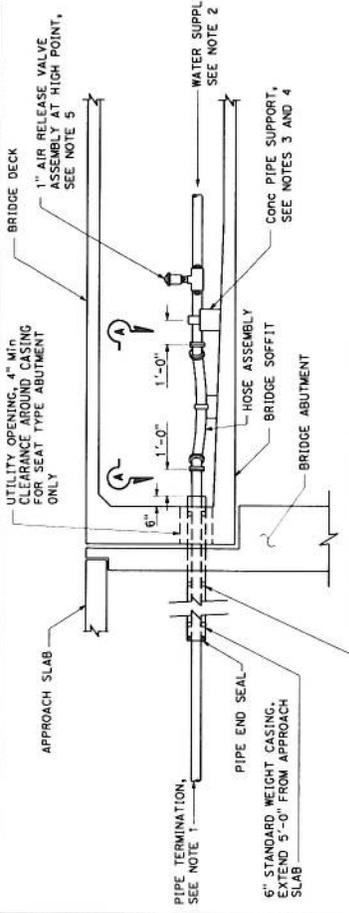
REGISTERED MECHANICAL ENGINEER
 Jay L. Phan
 No. 40300
 MECHANICAL ENGINEERING
 EXPIRES 8-31-12

PLANS APPROVAL DATE
 May 20, 2011

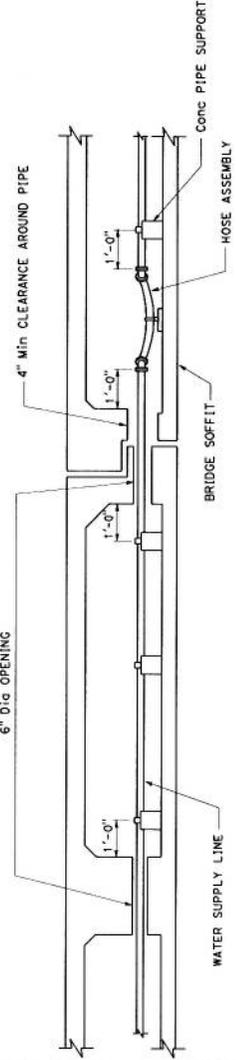
THE STATE OF CALIFORNIA OFFICE OF THE REGISTERED PROFESSIONAL ENGINEERS
 THE AUTHORITY OF THE STATE ENGINEERS
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**VIEW A-A
HOSE ASSEMBLY**

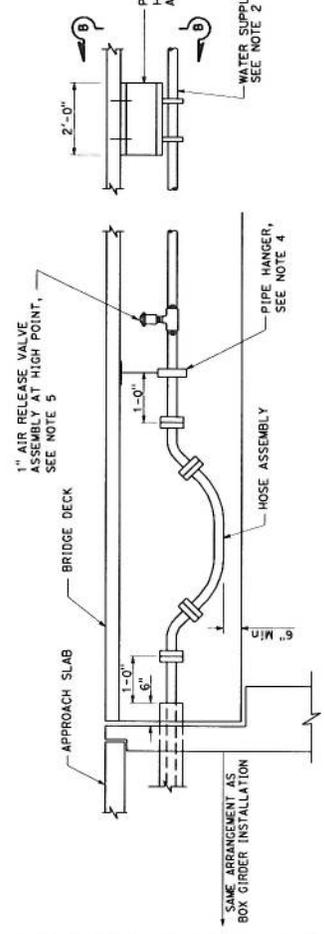


BOX GIRDER INSTALLATION



PIPE INSTALLATION AT HINGE

Some for hanger type installation



INSTALLATION FOR OTHER STRUCTURE TYPES

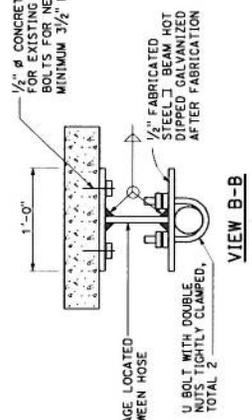
NUMBERED ITEM

- ① 45° flanged elbow with insulated flange connection
- ② Flanged hose fitting
- ③ Hose 6'-6" in length (size shall be same as pipe)

NOTES:

1. Extend pipe 5'-0"± beyond the edge of shoulder or as shown on bridge plans. Terminate in a pull box as shown on Standard Plan B14-3, Detail B.
2. Water supply line shall be installed parallel to bridge soffit or deck.
3. For concrete pipe support, pipe shall be tightly clamped at the pipe support located halfway between hose assemblies. At all other supports, pipe clamp shall be shimmed with steel washer plate to provide 1/4" clearance between pipe and clamp.
4. Maximum spacing between pipe hangers or supports shall be 10'-0" unless otherwise detailed on the plans.
5. Install air release valve using threaded tee or pipe saddle.
6. Openings through diaphragm and bent caps shall be 6" diameter unless otherwise detailed on the plans.
7. For details of pipe hanger and concrete pipe support see Standard Plan B14-5.

1/2" Ø CONCRETE EXPANSION ANCHOR FOR EXISTING BRIDGE, OR L-ANCHOR BOLTS FOR NEW BRIDGE, TOTAL 4, MINIMUM 3/2" EMBEDMENT.



VIEW B-B

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

**WATER SUPPLY LINE (BRIDGE)
(PIPE SIZES LESS THAN 4")**

NO SCALE

B14-4

STATE	COUNTY	ROUTE	POST MILES	SHEET NO.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

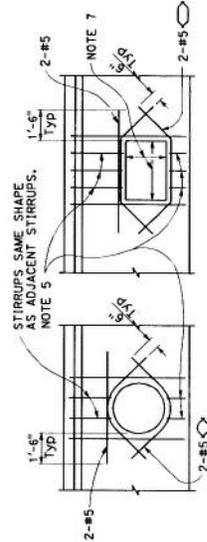
May 20, 2011
 PLANS APPROVAL DATE

DESIGNED BY: [Signature]
 CHECKED BY: [Signature]
 IN ACCORDANCE WITH THE PROVISIONS OF THE CALIFORNIA PROFESSIONAL ENGINEERING ACT AND THE REGULATIONS OF THE BOARD OF PROFESSIONAL ENGINEERS AND SURVEYORS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING AND SURVEYING. THESE PLANS HAVE BEEN CAREFULLY EXAMINED AND FOUND TO BE IN ACCORDANCE WITH THE PROVISIONS OF THE CALIFORNIA PROFESSIONAL ENGINEERING ACT AND THE REGULATIONS OF THE BOARD OF PROFESSIONAL ENGINEERS AND SURVEYORS FOR THE PRACTICE OF PROFESSIONAL ENGINEERING AND SURVEYING.

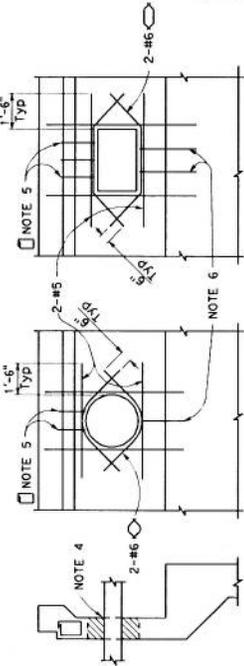
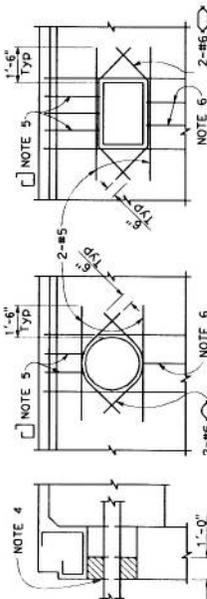
NOTES:

1. The exact location, elevation, size and direction of all utilities shall be shown on Project Plans and as directed by the Engineer.
2. Girders not shown. See Project Plans.
3. All reinforcement detailed to be placed in addition to reinforcement shown on Project Plans.
4. Seal utilities at abutments with concrete or mortar, or other tightly wrapping utility with 2 layers of 15 LBS building paper.
5. Reinforcement to be same bar size, and $\frac{3}{8}$ the spacing of adjacent reinforcement shown on Project Plans.
6. Reinforcement to be same bar size and shape as adjacent reinforcement shown on Project Plans.
7. For future utility opening dimensions, see Project Plans and Detail U-14.
8. When there is insufficient space to place reinforcement as shown, hook reinforcement into exterior girder.
9. Unless otherwise shown on Project Plans, casing shall extend to the 5'-0" beyond the end of the approach slab 5'-0" beyond the end of the adjacent wingwall, or 20'-0" beyond the back of the abutment.

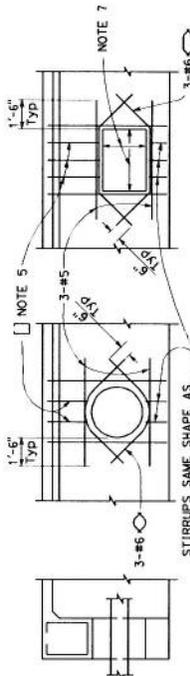
**DETAIL U-15
 INTERMEDIATE DIAPHRAGMS**



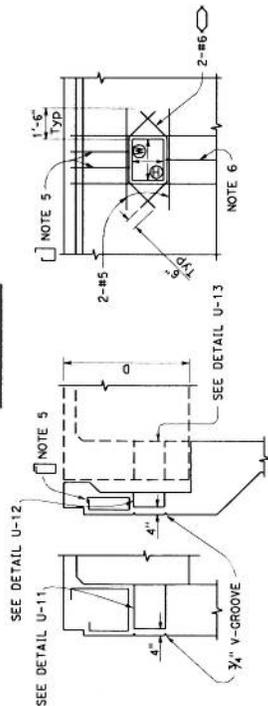
DETAIL U-11



DETAIL U-12



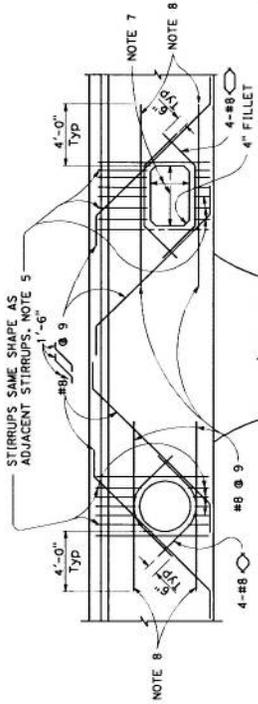
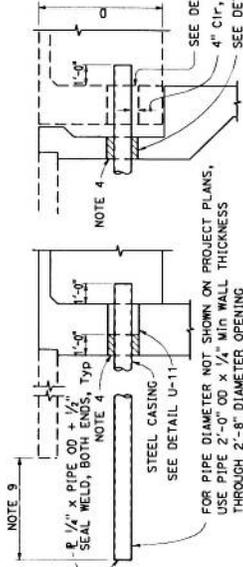
DETAIL U-13



For future utility opening dimensions not shown on Project Plans use:
 (U) = $\frac{1}{3}$ D or 1'-3" Min, whichever is greater.
 (H) = $\frac{1}{3}$ D or 1'-3" Min, whichever is greater.

**DETAIL U-14
 (For future utility opening)
 ABUTMENT DIAPHRAGMS**

**DETAIL U-16
 ABUTMENT DIAPHRAGMS**
 (For future utility provisions under approach slab)



**DETAIL U-17
 BENT CAPS**
 Near or between columns

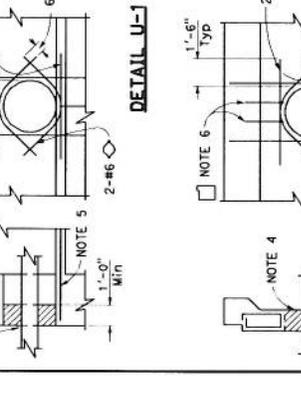
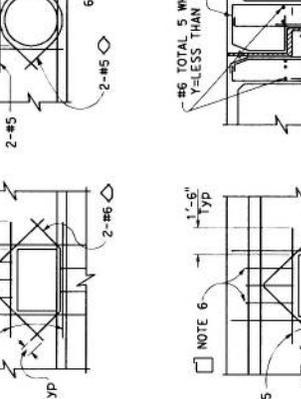
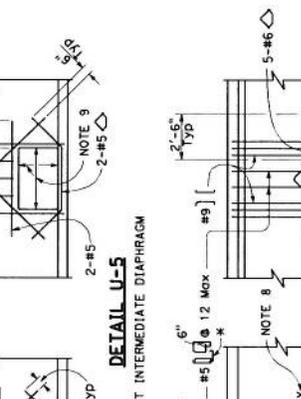
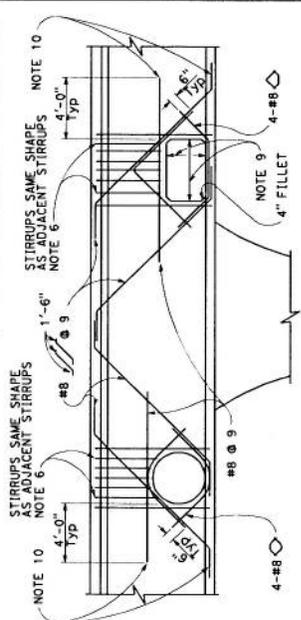
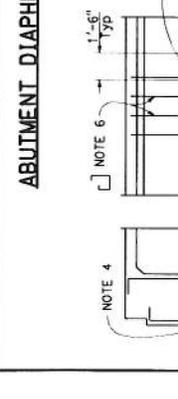
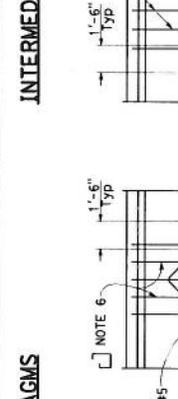
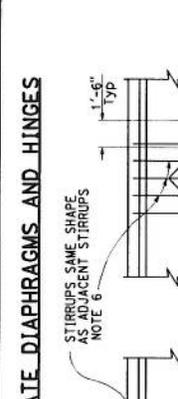
STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION
**UTILITY OPENINGS
 T-BEAM**
 NO SCALE

ABUTMENT DIAPHRAGMS

INTERMEDIATE DIAPHRAGMS AND HINGES

REGISTERED CIVIL ENGINEER
 MAY 20, 2011
 STATE OF CALIFORNIA
 THE ACCURACY OF THIS PLAN IS THE RESPONSIBILITY OF THE ENGINEER
 THE STATE OF CALIFORNIA DOES NOT GUARANTEE THE ACCURACY OF THIS PLAN

BENT CAPS
 STIRRUPS SAME SHAPE AS ADJACENT STIRRUPS
 NOTE 6
 STIRRUPS SAME SHAPE AS ADJACENT STIRRUPS
 NOTE 10



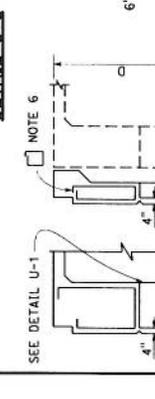
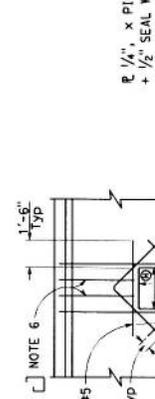
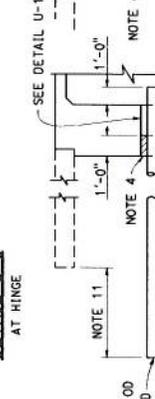
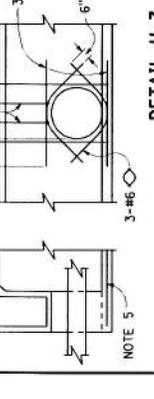
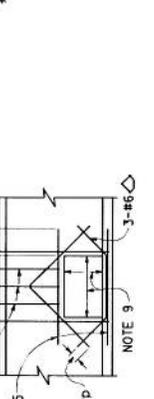
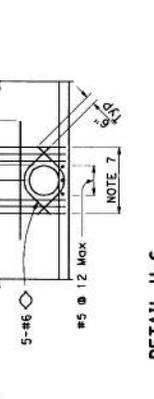
DETAIL U-7
 NEAR OR BETWEEN COLUMNS

DETAIL U-5
 AT INTERMEDIATE DIAPHRAGM

DETAIL U-3
 FOR FUTURE UTILITY PROVISIONS UNDER APPROACH SLAB

DETAIL U-4
 FOR FUTURE UTILITY OPENING

- NOTES:**
1. The exact location, elevation, size, and direction of opening shall be in accordance with the Project Plans and as directed by the Engineer.
 2. Girders not shown. See Project Plans.
 3. All reinforcement detailed to be placed in addition to reinforcement shown on Project Plans.
 4. Seal joints or openings with concrete or mortar, after tightly packing utility with 2 layers of 5 LBS building paper. If structure is prestressed, seal to be placed after stressing is completed.
 5. Main reinforcement to clear opening.
 6. Reinforcement to be same bar size and 1/2 the spacing of adjacent reinforcement shown on Project Plans.
 7. Replace each set of 2-#9 bars cut off by opening. Place 1/2 on each side of opening.
 8. When "y" is less than 8', extend top of opening to bottom of bearing seat elevation.
 9. For future utility opening dimensions, see Project Plans and Detail U-4.
 10. When there is insufficient space to place reinforcement as shown, hook reinforcement into exterior girder.
 11. Unless otherwise shown on Project Plans, casing shall extend to the greater of 5'-0" beyond the end of the approach slab, 5'-0" beyond the end of the adjacent wingwall, or 20'-0" beyond the back of the abutment.



DETAIL U-6
 AT HINGE

DETAIL U-2
 AT INTERMEDIATE DIAPHRAGM

DETAIL U-3
 FOR FUTURE UTILITY PROVISIONS UNDER APPROACH SLAB

DETAIL U-4
 FOR FUTURE UTILITY OPENING

DETAIL U-8
 FOR FUTURE UTILITY PROVISIONS UNDER APPROACH SLAB

DETAIL U-2
 AT INTERMEDIATE DIAPHRAGM

DETAIL U-3
 FOR FUTURE UTILITY PROVISIONS UNDER APPROACH SLAB

DETAIL U-4
 FOR FUTURE UTILITY OPENING

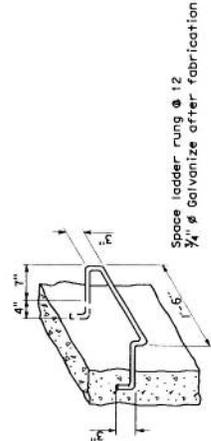
STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION
**UTILITY OPENING
 BOX GIRDER**

NO SCALE

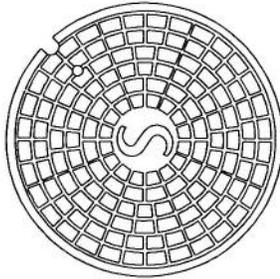
B7-10

DIST. COUNTY ROUTE TOTAL PROJECT SHEET NO. SHEETS

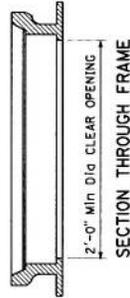
REGISTERED CIVIL ENGINEER
 May 20, 2011
 APPROVAL DATE
 REGISTERED CIVIL ENGINEER
 CS1113
 9-20-11
 THE ACCURACY OF THIS DRAWING IS THE RESPONSIBILITY OF THE ENGINEER. IT IS THE USER'S RESPONSIBILITY TO VERIFY THE ACCURACY OF THIS DRAWING BY SCANNING THE ORIGINAL DRAWING SHEET.



BAR STEP
LADDER RUNG DETAILS
 DETAIL U44

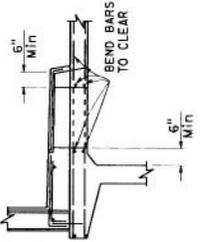


TOP OF MANHOLE COVER

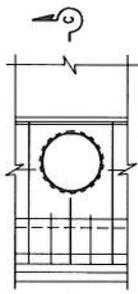


NON-ROCKING MANHOLE FRAME & COVER
 SECTION THROUGH FRAME
 FOR DECKS
 DETAIL U45

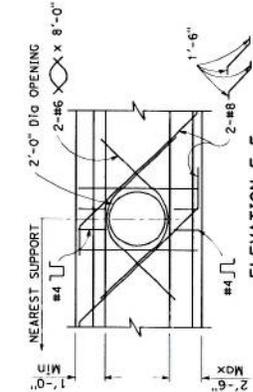
NOTE:
 1. Step inserts may be substituted for the standard step detail. Step inserts shall comply with State Industrial Safety requirements.



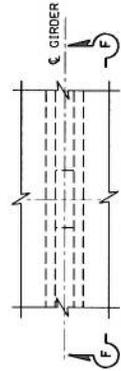
SECTION C-C



PART PLAN
SIDEWALK ACCESS OPENING
 DETAIL U42

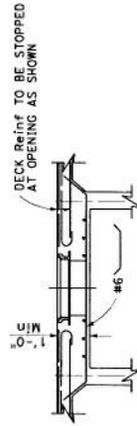


ELEVATION F-F

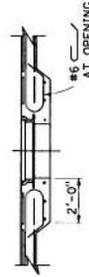


PART PLAN
GIRDER STEM ACCESS OPENING
 DETAIL U41

NOTES:
 1. For exact location of openings see other sheets.
 2. Location and size of manholes may be modified as directed by the Engineer, provided minimum dimensions are maintained.
 3. All reinforcement detailed to be placed in addition to reinforcement shown on other sheets.

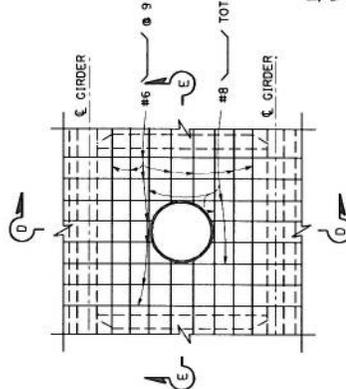


SECTION D-D



SECTION E-E

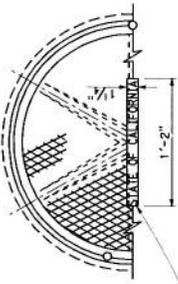
NOTE:
 Where manhole is located adjacent to a diaphragm or abut, substitute half Section E-E on one side of Section E-E.



PART PLAN

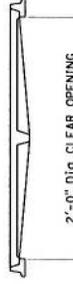
DECK ACCESS OPENING
 DETAIL U43

HALF SECTION E-E



LETTERS 1" HIGH, NO OTHER INSCRIPTION TO APPEAR ON EXPOSED SURFACES.

TOP OF MANHOLE FRAME & COVER



SECTION THROUGH FRAME & COVER
MANHOLE FRAME & COVER
 FOR SIDEWALKS
 DETAIL U46

NOTES:
 1. Frame and cover shall be cast iron.
 2. Cover shall be supplied with bolt down or locking devices.

STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION
UTILITY DETAILS
 NO SCALE